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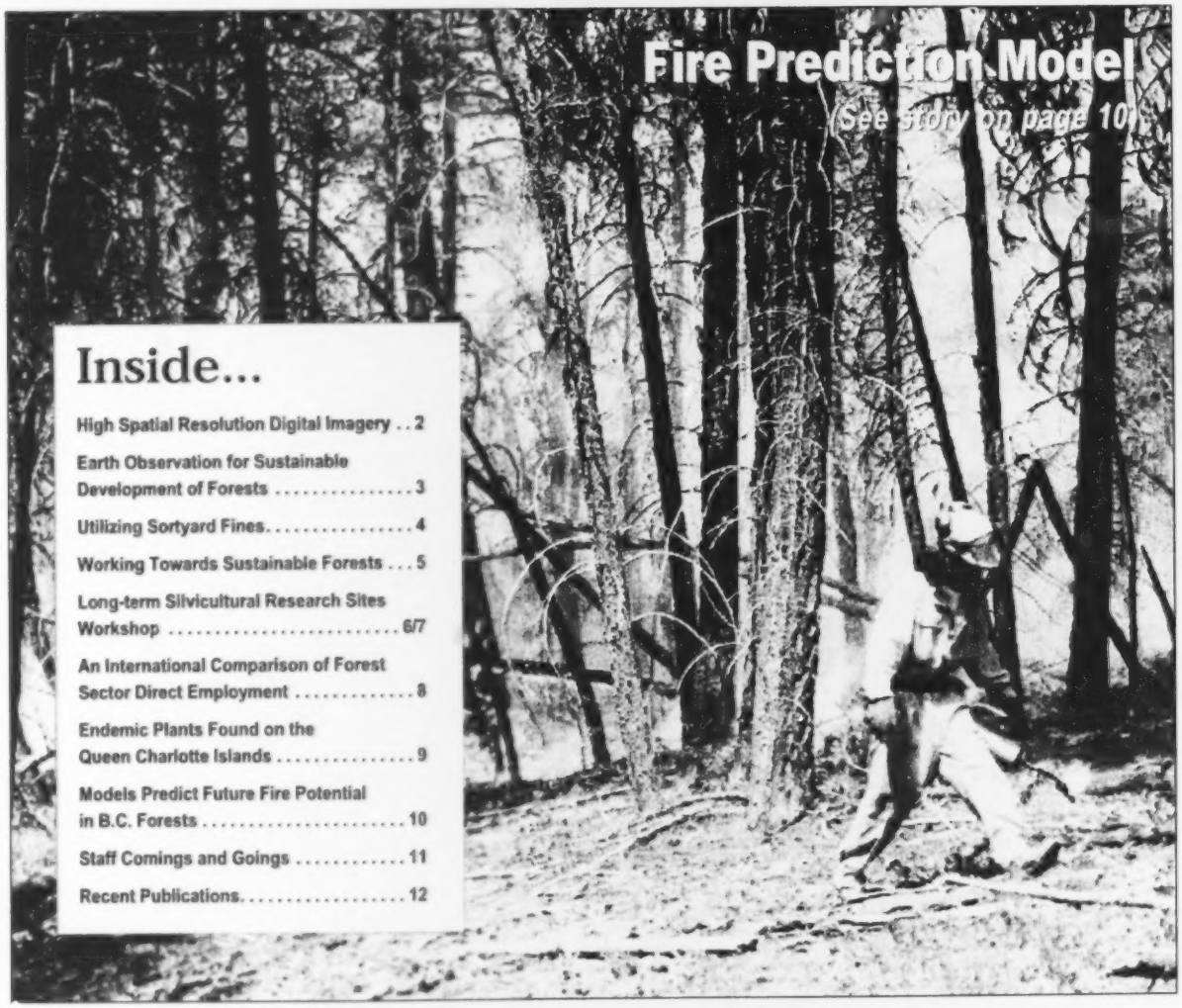

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High Spatial Resolution Digital Imagery

"High spatial resolution digital imagery may provide a quick and cost-effective means of surveying the forest."

Studies indicate that high spatial resolution digital imagery may provide a quick and cost-effective means of surveying the forest.

For three years, researchers at the Pacific Forestry Centre in cooperation with MacMillan Bloedel Ltd. and ITRES, a remote sensing company, with funding from Forest Renewal B.C., have been studying the feasibility of mapping forest parameters using data from the compact airborne spectrographic imager (CASI).

CASI is a programmable imaging spectrometer that can acquire visible and near-infrared multispectral imagery of the forest. Analysis of imagery at resolutions of 50 cm to 1 m permits automated interpretation on a single tree basis. Research results on CASI have been promising.

"Our studies indicate that CASI is able to apply high spatial resolution digital imagery data to various B.C. forestry management activities such as regeneration assessment, gap mapping, stream platform mapping and, to a lesser extent, root rot detection," says Dr. Don Leckie, a research scientist at the Pacific Forestry Centre, working in the Landscape Management Network. "It's a quicker and less expensive means of obtaining forest management parameters than using ground-based methods."

In its application to forestry, CASI is installed in light aircraft and flown over a forested area. Its optics project a line perpendicular to the flight path onto one axis of a two-dimensional CCD (charged coupled device). The image is dispersed spectrally along a different axis of the CCD and a complete spectrum is obtained. This process is repeated as the aircraft moves over the forest, creating a two-dimensional scene at high spectral resolution.

"We are looking at the use of CASI for some phases (tree counts, gaps and possible speciation) concerning inventory updating and habitat supply," says Nick Smith, Senior Resource Analyst, Corporate Forestry, at MacMillan Bloedel in Nanaimo, B.C. He's been working with Leckie and Dr. François Gougeon (also at the Pacific Forestry Centre) on the research. "The project is presently in the research proof-of-concept phase."

In an effort to share and discuss the advances in high spatial resolution digital forestry data with other researchers and potential users, the Pacific Forestry Centre, the B.C. Ministry of Forests, and MacMillan Bloedel hosted an international forum called "Automated Interpretation of High Spatial Resolution Digital Imagery for Forestry. See the August 1998 issue of Information Forestry for details on the forum.

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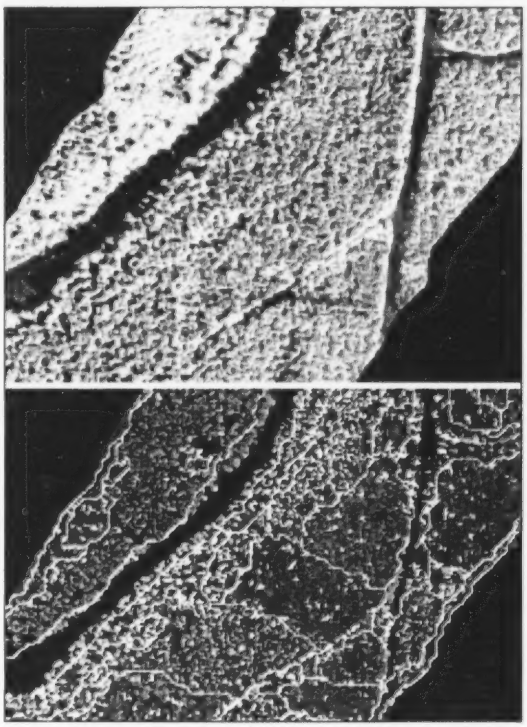

Pseudo-color infrared rendition of a 60 cm/pixel CASI image taken over central Vancouver Island and its computer analysis

Earth Observation for Sustainable Development of Forests

"The Earth Observation for Sustainable Development of Forests addresses one of the most important world-wide issues – climate change."

Canada has one-tenth of the world's forests. It is the largest trader of forest products, with over 20 percent of the world's forest trade. The Canadian forest sector contributes more than $50 billion to Canada's GDP and over $30 billion to our export trade balance. Canada has a global responsibility as well as a vested interest in the sustainable development of its forests.

In response to concerns about sustainable development and climate and the increasing information needs for national reporting, the Canadian Forest Service, in cooperation with the Canadian Space Agency and provinces and territories, is developing a 10-year project – Earth Observation for Sustainable Development of Forests (EOSD). Using space-based remote sensing technology and geographic information, EOSD will support Canada's priorities and international commitments for monitoring the sustainable development of its forests. It will meet the core forest information needs of the Kyoto Protocol, the international Convention on Biological Diversity, and the Framework Convention on Climate Change.

"Climate models indicate that Canada can expect major increases in temperature and changes in precipitation patterns," says Dr. David Goodenough, a senior research scientist working in the Landscape Management Network at the Pacific Forestry Centre. "Such changes will impact tree growth, insect population, fire rates, habitat suitability, water quality, vegetation cover, and the sustainability of current ecosystems. This project will quantify major changes in the composition, distribution, structure and function of forests over time."

The EOSD project will also develop and apply operational intelligent information systems for providing government, industry, academia and the public with access to accurate and timely spatial knowledge of Canada's forest resources. Earth observation data sets from EOSD and its derived products will be accessible over the web.

"In an era when nation monitors nation with remote sensing to assess compliance with international agreements, the EOSD project is intended to provide the Canadian and world-wide public with an unbiased, trustworthy picture of the current status of, and changes to, Canada's forests," says Goodenough.

Adds Dr. Les Whitney, Director of Technology Assessment at Geomatics Canada, "The Earth Observation for Sustainable Development of Forests addresses one of the most important world-wide issues – climate change."

EOSD will use new and historical LANDSAT and RADARSAT space data for all of Canada as well as hyperspectral, hyper-resolution and multi-frequency, multi-polarimetric SAR data for selected sites.

The EOSD project will be conducted in partnership with other federal departments as well as the provinces and territories. There will also be academic involvement in research tasks and industrial involvement in product development and research.

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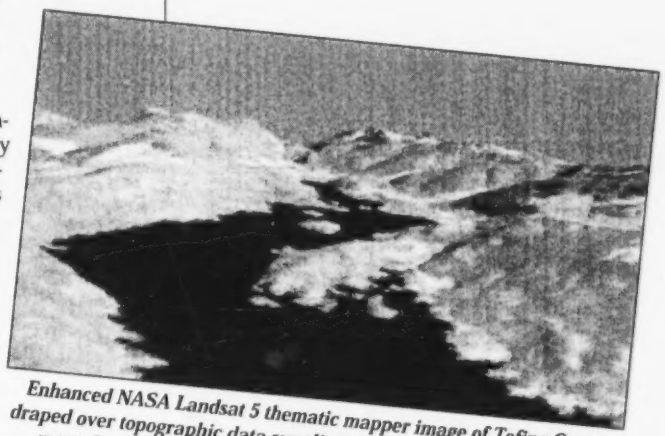


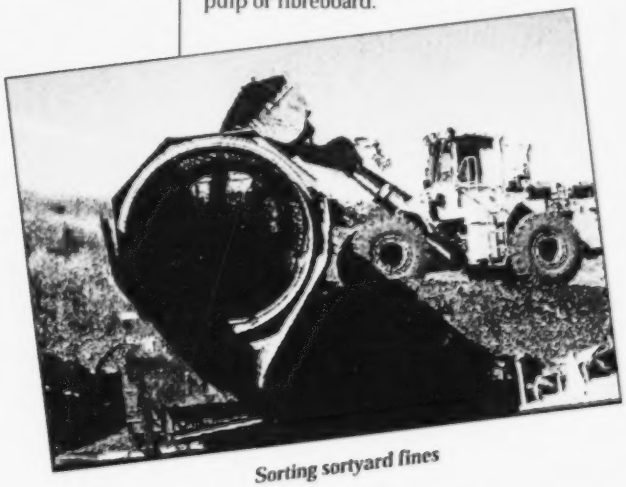
Enhanced NASA Landsat 5 thematic mapper image of Tofino Creek draped over topographic data supplied by the B.C. Ministry of Enivronment, Lands and Parks. Image enhancement and draping by the Advanced Forest Technologies Program, Pacific Forestry Centre.

Utilizing Sortyard Fines

"It may be possible to turn a disposal problem into a resource for sustainable forestry."

Disposing of residue from log handling is a major expense to most forest companies. It also raises environmental concerns. In B.C., a single year's worth of coarse wood residue could fill 3,680 barges, a line 185 kilometers long. The Pacific Forestry Centre in cooperation with the Forest Engineering Institute of Canada (FERIC) is researching the organic makeup of sortyard residues as a first step in turning them into higher-value environmentally-friendly commodities.

Historically, much of the residue was burned or dumped in landfills. New rules and regulations restrict burning and there are concerns about toxic leachate in landfills. While much of the residue generated in sortyards is currently reclaimed for materials such as wood chips, the fines (wood, bark, leaves, needles, gravel, and soil) present a challenge. Being approximately five cm or less, the fines are often high in ash and moisture content, and are thus unsuitable for adding to pulp or fibreboard.



Sorting sortyard fines

"Possible alternative uses for sortyard fines include landscaping products (mulches and topsoil mixes), land rehabilitation (logging roads and landings), composting material, or as fuel," says Dr. Caroline Preston, research scientist in soil chemistry at the Pacific Forestry Centre working in the Ecosystem Processes Network. "But it is first essential to determine that the material is environmentally benign. Determining ash and elemental concentrations is a relatively simple chemistry procedure, but understanding the organic makeup of the fines in terms of its carbon-containing building blocks is more challenging."

Once material is reduced to small particle size, mixed with dirt and exposed to the elements, traditional means of chemical analysis become almost impossible. However, a technique developed at the Pacific Forestry Centre provides a quick fingerprint of the carbon structures in woody residues. Using nuclear magnetic resonance spectroscopy (NMR), Dr. Preston can generate a fingerprint of the carbon structures in residue samples. The NMR technique can be used for many elements including hydrogen, nitrogen, phosphorous, silicon, aluminium and carbon.

"The research undertaken by the Pacific Forestry Centre and FERIC into the physical and chemical properties of sortyard fines is key to developing alternative uses for this material," says Patrick Forrester, researcher in Harvesting Operations at FERIC. "Dr. Preston's work has indicated ... that the chemical makeup of the fines is similar to that of woody soils which occur naturally in most forest systems."

Adds Preston, "So far we've sampled sortyard fines from sites on Vancouver Island, in the interior of B.C., and in Washington State. Our research shows that sortyard residue can be used directly or in combination with supplements for roadways, forest land additives, rehabilitation and perhaps urban landscaping. Sortyards can be rehabilitated easily for other uses without environmental concerns if there are no additional pollutants on the site."

Although further research is required, returning the material to the forest ecosystem as a soil amendment appears to be an option compatible with its origin and chemical properties. Research results from this study are currently being applied to a B.C. Ministry of Forests study in road rehabilitation.

"Understanding the organic makeup ... will result in new opportunities for utilizing this material that are cost effective for the forest industry," says Tony Sauder, Group Supervisor of Harvesting Operations at FERIC.

It may be possible to turn a disposal problem into a resource for sustainable forestry.

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Working Towards Sustainable Forests

"Studies ... may help preserve ecosystems and ensure sustainability of future timber supplies."

In B.C., the long-term effects of forestry operations on ecosystems are a serious concern. Studies show that from 1976 to 1985, soil degradation reduced annual wood yield by 400 000 cubic meters, and this is increasing by 50 000 cubic meters each year.

John Senyk, a research officer at the Pacific Forestry Centre, has been studying the effects of soil degradation in B.C.'s interior and the coastal montane forests of Vancouver Island for a number of years. Senyk's studies and other similar projects may help preserve ecosystems and ensure sustainability of future timber supplies.

"Years ago we recognized we were losing 25-30 percent of the cutblock land in the interior to soil erosion and mass wasting caused by ground-based operations like skid roads, trails and haul roads," says Senyk, working in the Effects of Forestry Practices Network. "It became apparent that these disturbances were having an effect on long-term forest productivity."

Sustainability of forests is threatened when ground-based operations cause compaction, displacement and a loss of nutrients in the soil. The harvesting operations can affect the soil's bulk density, porosity and chemistry, leading to inhibited root development and productivity. Soil degradation can also lead to landslides, which can affect entire ecosystems, leading to a loss of many different resources.

"In the interior of B.C. there has been a considerable change in forestry practices over the past ten years, but there are still ground-based operations going on," says Senyk.

In the mid-eighties, Senyk participated in a study in the Golden Forest District that focused on determining the effects of soil disturbance on long-term tree growth. Four clearcut blocks were chosen, and seedlings were planted on skidroad running surfaces, tracks, and adjacent undisturbed soil. While some trees were more sensitive to disturbances than others, the study confirmed that seedling growth is strongly related to soil disturbance. In general, the running surface and tracks had low soil porosity, high bulk density and a high susceptibility to water erosion, all of which contribute to reduced productivity. Forest managers are aware of the problem, and they're using the Forest Practices Code soil conservation guidelines, to which Senyk's research contributed.

"We have one specialist with an M.Sc. in Forestry who works specifically on this problem in order to maintain forest productivity," says Dennis Rounsville, Chief Forester at Crestbrook Forest Industries in Cranbrook. "At this point we do 100 percent skidtrail rehabilitation, and the trials we put out there are getting the growth we've anticipated."

In 1997, Senyk began to conduct research as a part of the MASS project (Montane Alternative Silvicultural Systems) in the high elevations of a coastal montane ecosystem south of Campbell River. In this study, soil disturbances from yarding and skidtrail rehabilitation were applied to five areas, and 920 of both western hemlock and amabilis fir seedlings were planted on the disturbed soil. After three growing seasons, the survival of amabilis fir was better than western hemlock in all the disturbance types.

These results, combined with the work of other studies, are helping forest managers work towards building sustainable forests.

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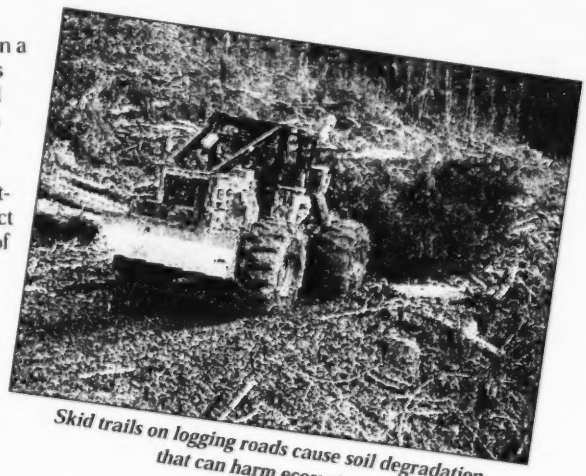


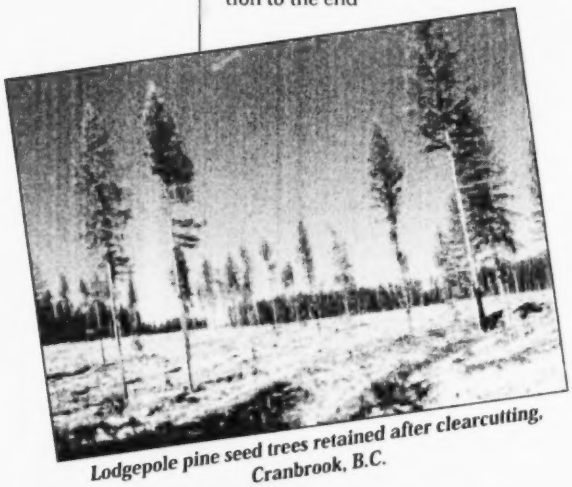
Skid trails on logging roads cause soil degradation that can harm ecosystems

Long-term Silvicultural Re
Promoting the Concept - F

"Participants came away... with ideas on how to promote their research site and keep them... productive."

A long-term silvicultural research sites workshop ran from October 25-28 at the Ocean Pointe Hotel in Victoria, bringing together researchers and representatives of industry involved in the management of the long-term research sites affiliated with the Forest Ecosystem Network of Sites (FERNS).

The workshop addressed topics such as data management, project planning and design, funding, promotion of interdisciplinary research, networking, and technology transfer and extension. Some of the main goals of the workshop included identifying opportunities for interaction and cooperation between FERNS sites, methods of delivering information to the end users, and opportunities to promote and sustain individual sites for long-term values.



Lodgepole pine seed trees retained after clearcutting, Cranbrook, B.C.

Acadian Forest near Fredericton, N.B.

Dr. Paul Addison, Pacific Forestry Centre Director General, gave participants an introduction to the workshop. "I want to give you a challenge to consider during this workshop," he said. "Talk to each other. We've got fantastic information, ideas, and projects, many of which are only known in one area. Use this workshop as a tool to link people and projects, and to learn and share with each other."

The workshop was divided into three themes, including "planning for the long term", "long-term silvicultural research sites", and "getting the goods out". Each session started with a keynote address from leaders in the forest sector or researchers involved with long-term sites in Canada or the United States. Through listening to the speakers and attending the breakout discussion sessions that followed, participants developed specific recommendations and ideas to promote the productivity of their sites. There was also a field trip to the Shawnigan Lake Research Forest, and a trip to the Pacific Forestry Centre where workshop participants met researchers.

Keynote speakers of the workshop included Dr. Bill Emmingham (Oregon State University), Dr. Jerry Franklin (University of Washington), Mr. Tony Rotherham (Canadian Pulp and Paper Association), and Dr. Larry Speers (Canadian Biodiversity Information Initiative).

Keynote speaker Dr. Bill Emmingham, an Extension Silviculture Specialist at Oregon State University, spoke on connecting long-term studies to short-term goals in the forest sector. "I believe that long-term and large-scale silvicultural research is critically needed to integrate and test the results of specific silvicultural systems or approaches to management of forests," he said. "There should be, and to some extent there exists, a common goal among managers, educators and researchers to find the best combination of practices to carry out a truly sustainable forest management."

Emmingham explained the importance of researchers, as the ultimate planners and perpetrators of long-term silviculture research projects and sites. Researchers, he said, along with managers and educators, must realize that resources will likely have to be managed

esearch Sites Workshop - Protecting the Investment

differently sometime in the future, and experiments will have to test a wider range of options than today's experiments. Emmingham also emphasized the significance of organized research, "Stability in leadership and funding are crucial in providing key researchers with the long tenure important in the context of maintaining long-term silviculture trials."

Other highlights in Emmingham's presentation included recommendations for large sized experiments, wide scopes of treatments, many multi-disciplinary researchers, and a dedicated technology transfer staff with active educational programming for a variety of audiences.

Dr. Robert Powers, Principal Research Silviculturist and Science Team Leader at the Pacific Southwest Research Station, USDA Forest Service, gave workshop participants a few ideas on supporting long-term research. His presentation, called "If you build it will they come? Planning/Designing for Long-Term Success", focused on the reasons current forestry research isn't getting the desired results.

"Long-term research is so clearly in everyone's interest that it may seem surprising that support has been so meager," says Powers. "Failures trace to studies of narrow scope and to weak communication of their significance."

Powers emphasized the elements that a few successful projects have in common. These include: an umbrella theme with universal appeal; crisp and testable hypotheses with interdisciplinary elements critical to scientific progress; clear application to realistic problems; large, replicated plots providing scientific rigor and flexibility; factorial treatments offering strong inferences; sustained commitment from scientists and administrators; and enough bureaucracy to prevent chaos.

Powers sited many past research projects and identified their reasons for success or failure, giving workshop participants a strong base to deal with current issues and plan for the future in silviculture.

Keynote speaker, Dr. Jerry Franklin, professor of Ecosystem Science and Conservation at the College of Natural Resources, University of Washington, spoke to workshop participants on the importance and challenge of long-term and large-scale research. Franklin not only echoed the concerns of other speakers by emphasizing how critical long-term research is, but also focused on the problems related to small-scale, short-term projects. "There are a variety of techniques to shortcut time on data collection, but ultimately only long-term, large-scale experiments will provide the critical tests of management hypotheses and models," he said.

Franklin also emphasized the selection of silvicultural treatments within the design of long-term experiments. He said it's important to have significant contrasts among treatments, perhaps even including extreme treatments. This will minimize ambiguity in responses and better illuminate the replication. In addition, it's important to have treatment areas of sufficient size. Confounded treatment variables are a typical problem in traditional silvicultural research, and foresters often compare silvicultural systems in which several stand variables are altered simultaneously.

Franklin also discussed the challenge of acquiring long-term financial support. "Ultimately, new mechanisms, such as creation trusts, are needed to insure continuity of funding," he says. "Some research groups have already formed foundations with an objective of creating trust funds which can sustain critical measurement programs during periods of inadequate funding."

Dr. Larry Speers from the Canadian Biodiversity Information Initiative discussed the future directions of biological data management. Speers feels that continuing advancements in computer technology have resulted in common place access to a level of computing power that now makes it cost effective to apply large-scale information processing technologies to the analysis of complex biological systems. "Until recently, most advances in biological informatics have been geared towards handling molecular biology data," says Speers. "We need to incorporate the

story continued on page 11

An International Comparison of Forest Sector Direct Employment

"Many developed economies are examining options to stimulate direct employment through public intervention."

The integration and linkage of global institutions and markets has served to create an international standard for performance and efficiency. This in turn has reinforced the signals which draw capital investment, manufacturing activity and consequently, employment. Many developed economies are experiencing significant labour displacement and underemployment as industry shifts in response to investment opportunities and technological change.

"In response to pronounced and prolonged structural unemployment, many developed economies are examining options to stimulate direct employment through public intervention," explains Dr. Bill Wilson, Director of Industry, Trade and Economics at the Pacific Forestry Centre and member of the Socio-economic Research Network. "Forestry has a broad history of such policy intervention. In forestry such interventions include enhanced resource access, trade restrictions, capital and factor subsidies, market development aid, funding for research and development, and labour training support."

A comprehensive examination of a selection of forestry jurisdictions was completed in an effort to identify any differences in the level of direct employment in forestry. This information was necessary in order to identify which jurisdictions were relatively more successful in securing higher employment levels in forestry and warranted further work to study the factors and policies which contributed to this improved employment.

Employment and harvest levels were developed for B.C., Alberta, Ontario, Washington, Oregon, Sweden, Finland, and New Zealand. Each of these jurisdictions generate significant economic activity, employment and export earnings from forestry.

A coefficient of direct employment per thousand cubic meters of timber harvested was estimated for each of these jurisdictions. In order to develop an accurate comparable estimate, adjustments were made for imported fibre, recycled fibre, intra-state fibre flows, exchange rates, direct employment estimates and differences in salary structures.

"To create a valid comparison of forest sector employment requires a standardized measure for direct employment, adjusting for differences in the definitions of forest sector employment and timber harvest volumes," adds Wilson. "Once we determined the measurement by which we could make an accurate comparison, we found there was very little statistical difference in the amount of employment resulting from an equivalent amount of timber harvest."

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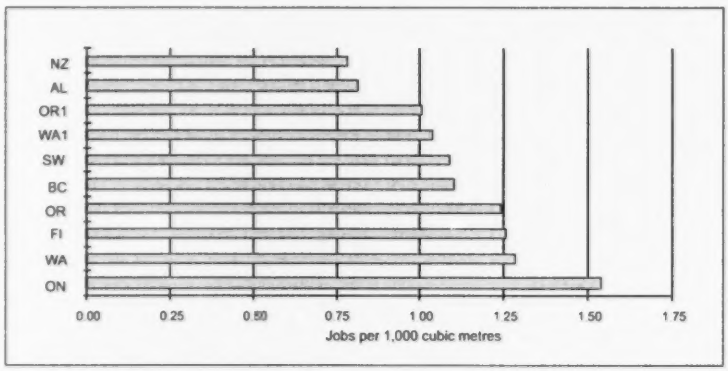

Standardized estimates of jobs per thousand cubic meters harvested, adjusted for differences in wage rates, 1993.

BC = British Columbia, AL = Alberta, ON = Ontario, WA = Washington, OR = Oregon, SW = Sweden, FI = Finland, and NZ = New Zealand. WA1 and OR1 are alternative estimates based on the reported volume of timber used in lumber production. Source: Delcourt, G.; Wilson, W. 1998. Forest industry employment: a jurisdictional comparison. Canadian Public Policy. Vol. XXIV.

Endemic Plants Found on the Queen Charlotte Islands

"Senecio Newcombe *is abundant on the Islands, but nowhere else in the world."*

The Queen Charlottes are a group of approximately 150 islands that are known internationally for their unique environment.

The South Moresby Forest Replacement Account (detailed in Information Forestry, August 1998), co-funded by the Canadian Forest Service and the B.C. Ministry of Forests, supports silviculture projects on the Charlottes. A recent project resulted in the identification of 25 new plants that had not previously been known to grow on the Islands. And of 657 vascular plant species in the area, nine are recognized as endemic; species that are found only on the Queen Charlottes.

"You can look at endemism on a large scale or a small scale," says Jenifer Penny, assistant botanist with the B.C. Ministry of Environment, Lands and Parks, which maintains a database of the province's rare plants and animals. "Eight of the plants identified are recognized as endemic because they are found only in the Central Coast region, of which the Charlottes are a part. Seven of the endemic species are also found on the Brooks Peninsula. But one plant, a yellow daisy called *Senecio Newcombe*, is completely endemic to the Queen Charlotte Islands."

Senecio Newcombe is abundant on the Islands, but nowhere else in the world. The reason for this may be due to what's been termed the glacial refugia theory, whereby certain areas of the Islands were not covered by ice during glaciation, allowing some plants to grow and creating a unique habitat. The coastal climatic zones of the Charlottes may have been poor conditions for ice, but they were ideal for the *Senecio Newcombe*. Besides this plant, the Islands have 41 plants that are on the B.C. rare or endangered list. Seven of those plants are considered globally rare.

"Traditionally, people want to protect showy plants," explains Penny. "But all plant species contribute to biodiversity and should be valued for their diversity."

Endemic plants were the focus of one in a series of lectures sponsored by the South Moresby Forest Replacement Account in celebration of its 10th anniversary.

For more information about the South Moresby Forest Replacement Account, contact Greg Wiggins, Program Coordinator at **Greg.Wiggins@gems3.gov.bc.ca.**

The Queen Charlotte Islands is the only place in the world where* Senecio Newcombe *is found
(Marlene Specht - illustrator)

Models Predict Future Fire Potential in BC Forests

"Understanding the issue of forest in-growth as a result of fire suppression is vitally important."

In 1998, wildfires in B.C. destroyed over 78,000 hectares of forest and cost over $140 million to fight. While the combination of high temperatures and dry conditions were partly to blame, researchers at the Pacific Forestry Centre believe forest fire potential may have been increased by the impacts of today's forest management practices.

Steve Taylor, a researcher at the Pacific Forestry Centre, working in the Fire Management Network, has spent the past three years examining the effects of forest management practices such as fire suppression. His research currently involves models designed to forecast the long-term effects of forest management practices on forests, as well as studying the historic rate of change in forest cover and composition.

"There has been substantial changes in forest cover and composition in many southern interior forests in the past 40 years," says Taylor. "Forest in-growth is occurring due to a number of factors including fire suppression, cattle grazing, and selective logging."

Forest in-growth refers to an increase in the numbers of trees in the lower canopy, leading to dense stands. In-growth can result in a reduction of forage production for forest grazing, a reduction in habitat for wildlife species, a decrease in forest health, and an increased risk of catastrophic wildfires.

"Understanding the issue of forest in-growth as a result of fire suppression is vitally important," says Don Gayton, a range ecologist with the B.C. Ministry of Forests in the Nelson Forest Region. "This project is valuable in establishing baseline information that we need, like the loss of wood value from a fire, or the impact of fires on forage production for elk, sheep and deer."

Historically, southern interior ponderosa pine and Douglas-fir forests were maintained by naturally occurring surface fires, which would keep the stands open while maintaining grasslands.

"The risk of a crown fire is much less in open stands, but because of in-growth we've got closed stands with a lower and more continuous canopy, and the crown fire potential is higher," says Taylor. "There's a concern that more severe fires are happening, so we're developing models to quantify and project changes in fire behavior potential resulting from changes in forest composition and management practices."

The ideas behind the project began in 1992, when Taylor began working with the BC Ministry of Forests on a pilot project called Ecosystem Maintenance Burning Evaluation and Research (EMBER).

"When we were working on EMBER, it became apparent that models were needed to help plan stand treatments and restoration programs," says Taylor.

With funding from Forest Renewal B.C, Taylor began working with the U.S. Forest Service and ESSA Technologies to develop a metric version of their Forest Vegetation Simulator (FVS) Fuel Dynamics and Fire Effects Model (FEDEM), used to predict regeneration, growth and natural mortality between fire events. To incorporate specific B.C. data, the metric version was later integrated with the B.C. variant of the FVS growth model (SimProg) developed by the B.C. Ministry of Forests. Once completed, a Windows interface was built to control the model's functions in a user-friendly way.

The project also examined changes in forest composition and fire potential in four study areas in southern interior B.C. By incorporating base maps, air photos, tree list data and historical weather records, Taylor and his team were able to develop techniques to predict fire potential.

By using Taylor's research to determine wildfire behavior potential, resource managers will be able to put ecosystem restoration and maintenance programs into place, which will decrease the risk to timber supply and other resources.

Steve Taylor can be reached at
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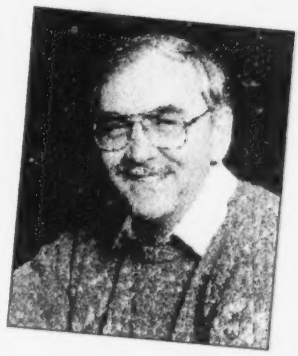
cover photo: Forest managers lighting ground fires for prescribed burning of a stand

Staff Comings and Goings

Dr. Yvan Hardy, Assistant Deputy Minister of the Canadian Forest Service, recently announced the appointment of **Dr. Paul Addison** as Director General. Besides being responsible for the direction, planning and management of Pacific Forestry Centre programs, Paul is Network Director General for the two scientific networks led by the Pacific Forestry Centre (Effects of Forestry Practices and Landscape Management) and is the contact person for the Canadian Forest Service in British Columbia and the Yukon.

Prior to his current appointment, Dr. Addison managed both the Forest Biology and Forest Resources Programs at the Centre, and the Forest Resources and Environment Division at the Great Lakes Forestry Centre. He was also the Network Manager for the Canadian Forest Service Effects of Forestry Practices and Landscape Management Networks and led the Green Plan Forestry Practices Initiative in the early 1990s. From 1984-89, he coordinated the acid rain, climate change, and environmental protection and assessment files for Forestry Canada in Ottawa. As a Research Scientist at Northern Forestry Centre (1976-84) he carried out ecological and physiological research into the effects of air pollution in both boreal and mountain forest ecosystems.



Dr. Addison obtained both B.Sc. (Biology) and M.Sc. (Ecology) degrees from Laurentian University in Sudbury in 1970 and 1973 respectively and a Ph.D. (Botany) in ecology from the University of Alberta (1976).

FERNS story continued from page 7

value of biodiversity in our economic calculations and tie it into our policies so we have more of an information base for decision making."

Speers also stressed that those countries with large investments in science-based industries such as agriculture, fisheries, forestry and environmental management should put in place the capabilities required to manage, and the new knowledge issuing from biological research.

These speakers were only a few of many speakers that gave presentations during the workshop. Other speakers came from universities, industry, and from forest sectors of other provinces and countries.

Mr. Larry Pedersen, Chief Forester, B.C. Ministry of Forests, gave an excellent addition to the opening remarks of the workshop, and Dr. David Ford of the University of Washington, wrapped up the workshop with his closing remarks.

Participants came away from the FERNS workshop with ideas on how to promote their research sites and keep them alive and productive. Proceedings consisting of a collection of short papers from keynote speakers, oral presentations, and recommendations will be published in The Forestry Chronicle in early 1999.

For more information, go to the FERNS website: http://www.pfc.cfs.nrcan.gc.ca/practices/ferns.htm

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Recent Publications

Inventaire des forêts du Canada 1991 : version 1994 – Supplément technique.
Gray, S.L.; Power, K. Rapport d'information BC-X-363F.

An annotated bibliography of the forest tent caterpillar, *Malacosoma disstria*.
Otvos, I.S.; Payne, L; Kilvert, V.; Conder, N. Information Report BC-X-380. 173 p. (available on-line only).

White pine weevil, *Pissodes strobi*: risk factors, monitoring and management.
Alfaro, R.I. Technology Transfer Note No. 4.

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Alfaro, R.I. Notes de Transfert Technologique. Numéro 4.

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Otvos, I.S.; Maclauchlan, L.E.; Hall, P.M.; Conder, N. Technology Transfer Note No. 11.

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The entire volume is available only in limited quantities. The papers in this issue can be downloaded in Acrobat format from the PFC on-line bookstore at http://bookstore.pfc.cfs.nrcan.gc.ca
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